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ABSTRACT

This paper describes a study aimed at expanding research on the interactive effect of readers' prior knowledge and text coherence on learning by introducing a third variable, topic interest, which is, the readers' relatively stable affective orientation toward a topic. The hypothesis was that the inferential processes required to fill in information gaps cannot be activated by prior knowledge, topic interest, and their interaction. High school students (n=160) were selected from a wider sample on the basis of their levels of prior knowledge and topic interest to make up 4 groups: (1) high knowledge with high interest; (2) low knowledge with low interest; (3) high knowledge with low interest; and (4) low knowledge with high interest. Students in each group read one of three versions of a scientific text about the greenhouse effect, which differentiated regarding cohesion level. They then carried out four tasks aimed at tapping both superficial and deeper levels of text understanding. It was expected that high-knowledge and high-interest readers would perform best regardless of text coherence, and high-knowledge and low-interest readers would perform better with globally coherent text, as would low-knowledge and high-interest readers. Low-knowledge and low-interest readers were expected to perform worst, especially with minimally coherent text. Results substantially confirm the hypothesis and show the complex interaction between cognitive and affective aspects on learning from text. When prior knowledge is low, topic interest can compensate for it and may help text understanding at text base level. When prior knowledge is high, high topic interest may help understanding at the level of text base. In two of the four tasks, the high-knowledge and high-interest group, which performed best in all tasks, benefited more from reading a minimally coherent text, but in general, the other groups scored highest reading a locally and globally coherent text. Future research questions and educational implications are outlined. (Contains 5 figures, 2 tables, and 27 references.) (Author/SLD)

Prior knowledge, text coherence, and interest: How they interact in learning from instructional texts

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Abstract

This paper introduces a study aimed at expanding previous research on the interactive effect of readers' prior knowledge and text coherence on learning by introducing a third variable, *topic interest*, that is the readers' relatively stable affective orientation towards a topic. The hypothesis was that the inferential processes required to fill in information gaps cannot be activated by prior knowledge, topic interest, and their interaction. The high school students who participated in this study (N=160) were selected from a wider sample on the basis of their level of prior knowledge and topic interest to make up four groups: high knowledge with high interest, low knowledge with low interest, high knowledge with low interest, and low knowledge with high interest. The students in each group read one of three versions of a scientific text about the greenhouse effect, which differentiated regarding cohesion level. They then carried out four different tasks aimed at tapping both superficial and deeper levels of text understanding. We expected that high-knowledge and high-interest readers would perform best regardless of text coherence. On the contrary, high-knowledge and low-interest readers would perform better with the globally coherent text as well as low-knowledge and high-interest readers. Low-knowledge and low-interest readers would perform worse, especially with the minimally coherent text.

The results substantially confirm our hypotheses and show the complex interaction between cognitive and affective aspects on learning from text. It emerges that when prior knowledge is low, topic interest can compensate for it and may help understanding a text at text base level. When prior knowledge is high, topic interest may help not only understanding at the level of text base but also situation model. In two of the four tasks, the high-knowledge and high-interest student group, who performed best in all tasks, benefited more from reading a minimally coherent text, whereas, in general, the other groups scored highest reading a locally and globally coherent text. Future research questions and educational implications are outlined.

Introduction

The development of text processing research in the last two and a half decades has produced a conceptualization of text comprehension as a complex and dynamic process by which a reader makes a coherent representation of the meaning of a text (e.g. Britton & Graesser, 1996; Gernsbacher, 1994; Kintsch, 1988, 1998; Weaver, Mannes, & Fletcher, 1995). Two main factors contribute to this representation. The first is text coherence, that is the degree to which sentences and parts of a text are connected, thus facilitating a coherent text representation. The other factor is the reader's contribution; a text does not give all the information required for its comprehension, and the reader has to fill in the information gaps by inferential activity, that is using his/her prior knowledge regarding the text's topic and structure (Mannes & Kintsch, 1987).

The concept of text comprehension as the integration of text information and reader's prior knowledge has an obvious instructional implication. As several studies have shown (e.g. Britton & Gulgoz, 1991), text coherence is a variable which can be manipulated to improve learning from text. Recently Kintsch and his coworkers (McNamara & Kintsch, 1996; McNamara, Kintsch, Songer, & Kintsch, 1996) have emphasized a problematic aspect of text coherence. On the one hand, a coherent text - that is a text in which sentences are tightly connected by coreference and causal links - is generally easier to recall. On the other hand, an easy text is not a demanding one for a reader, in that it reduces his/her need for active processing. Thus, a coherent text facilitates learning, but a less coherent one can stimulate the reader's active processing more, and leads therefore to more effective learning. According to Kintsch, the contradiction can be overcome in the theoretical framework of the construction-integration (CI) model of text comprehension (1988; see also van Dijk & Kintsch, 1983), and particularly in the light of the distinction between two levels of understanding: the text base and the situation model. The text base is a propositional representation of the information expressed in the text. Its construction involves the extraction of semantic information from a text at both local (microstructure) and global (macrostructure) levels, and its coding into a coherent network of propositions. The situation model is the result of the integration of the reader's prior knowledge of a topic and the information provided by the text. Learning from text is more than forming a

good text base (Kintsch, 1994a, 1994b, 1998). It implies a situation model, that is a mental representation of the text topic linked to the reader's long term memory. Within this framework, the contradiction between a coherent text which facilitates learning and a difficult (little coherent) text which makes learning active, can be overcome. The formation of a situation model - which is the requisite for deep understanding - requires the reader to have adequate prior knowledge of a topic and active inferencing. One way to promote the construction of a good situation model is to disrupt the coherence of a text, thus encouraging readers to use their prior knowledge to bridge text gaps by inferential activity.

McNamara and Kintsch (1996) and McNamara et al. (1996) have found overall that high-knowledge readers perform better after reading a low-coherence text in the tasks aimed at tapping deep comprehension, that is text inference, problem-solving questions and sorting tasks. Readers who knew little about the text topic benefited more from a globally coherent version of the same text.

The authors considered the effects and interactions of two main variables on learning from text: text coherence and readers' prior knowledge of the topic. A third variable, which seems to be crucial in learning from instructional text, is the reader's degree of interest in a topic (Hidi & Baird, 1986). Studies on interest conducted since the mid 80s have emphasized the role of interest in learning, and its relationship with the learner's prior knowledge (Renninger, Hidi, & Krapp, 1992; Tobias, 1994). Hidi (1990) introduced the useful distinction between situational and individual interest. The first is generated by certain conditions and/or environmental stimuli such as novelty and intensity, which contribute to the "interestingness" of a situation. In the 80s and 90s research on situational interest mostly focused on how the topic, or certain parts of a text, can affect a reader's comprehension and memory (text-based interest). Individual interest is a relatively stable evaluative orientation towards certain domains. According to Schiefele (1996, 1998), interest includes a value component differentiated into feeling-related and value-related valences. The first refers to feelings associated with an object ("I am involved in it"). The second refers to the attribution of personal significance to an object ("It is important to me"). Topic interest is a more specific form of individual interest. Whereas individual interest concerns domains of knowledge, topic interest regards a more restricted field and/or a material object.

Several studies have investigated the influence of interest on learning from expository texts (e.g. Hidi & Anderson, 1992; Schiefele, 1996; Schiefele & Krapp, 1996; Wade, 1992). Schiefele's (1996) study analyzed the effect of topic interest on different levels of text learning. He found that highly interested readers (senior high school students) developed a representation of the text's meaning, whereas low interest readers assimilated the text superficially. This result was independent of the students' levels of prior knowledge. Schiefele assessed the participants' text comprehension by sentence recognition and sentence verification tasks, whereas McNamara et al. (1996) adopted various measures, such as free recall, sorting, bridging-inference questions, etc., to match the two meaning representation levels of text base and situation model. Topic interest was also found to be significantly related to recall of idea units, elaborations, and main ideas, independently of prior knowledge (Schiefele & Krapp, 1996).

The study introduced below focused on three crucial variables - text coherence, prior knowledge and interest - which have generally been investigated separately, or in their two by two (prior knowledge and coherence; interest and prior knowledge) relationships. A basic assumption of the study was that analyzing all the relationships between three variables is a necessary condition for a deeper insight into the complex process of learning from texts.

Objective and hypotheses of the study

The purpose of the present study was to expand previous research on the interactive effect of readers' prior knowledge and text coherence on learning. The findings were expanded by introducing topic interest into the present study as a third variable that may interact with prior knowledge and text coherence levels to produce various effects on learning from texts. The inferential processes required to fill in information gaps may in fact be activated by prior knowledge, topic interest, and their interaction. We expected that high-knowledge and high-interest readers would perform best regardless of text coherence. On the contrary, high-knowledge and low-interest readers would perform better with globally coherent text as well as low-knowledge and high-interest readers, since either prior knowledge or topic interest would activate inferential processes, but

these would be facilitated by a more coherent text. Moreover, low-knowledge and low-interest readers would perform worst, especially with the minimally coherent text.

Method

Participants and design

First phase

In the first phase of the study 302 high school students (10^{th} and 11^{th} graders) aged between 15.8 and 17.9, attending a public "Ginnasio-Liceo Classico" in the town of Lecce (south eastern Italy) were involved. There were 210 girls and 93 boys. They shared a homogeneous middle class social background. The experimental design included three between-subject variables of text (minimal coherence, local coherence, local and global coherence), prior knowledge (low knowledge, high knowledge), and topic interest (low interest, high interest). The 302 participants were tested in order to determine individual differences and then select four groups of students with:

1. high prior knowledge and high topic interest (HH);
2. low prior knowledge and low topic interest (LL);
3. high prior knowledge and low topic interest (HL);
4. low knowledge and high topic interest (LH).

The selection of the students was based on their scores in the following three tasks that were administered in the classroom in a session which lasted approximately one hour.

a. A diagram with a schematic representation of the earth and sun. The students - who were to be introduced to a text on the greenhouse effect in the second phase - were asked to insert words about surface warming of the earth which were written below the diagram, and to link with arrows the words they saw as connected. The words were: atmosphere, solar radiation, water vapor, clouds, carbon dioxide, earth irradiation, ozone, greenhouse effect (the maximum score was 10).

b. A true-false and multiple-choice prior knowledge questionnaire on the greenhouse effect. Some examples of items are: "If there were no greenhouse effect, there would not be life on earth"; "The gases which cause the greenhouse effect absorb solar radiation"; "Carbon dioxide is the most powerful greenhouse gas";

"Holes in the ozone layer will increase the greenhouse effect". The maximum score was 11.

For each student a total score was calculated by adding the scores for the diagram and questionnaire to select those with the highest (from 10 to 15) and lowest levels of prior knowledge (from 0 to 5).

c. A topic interest questionnaire with 9 items to be rated on a five-point Likert type scale. Two aspects or components of interest were distinguished: feeling-related and value-related valences (Schiefele, 1996, 1998). Feeling-related items included: "I get excited when I read texts on ecological problems"; "I would like to know more about the greenhouse effect"; "I find it difficult to understand ecological problems". Examples of value-related valences included: "I think that teachers should give more time to questions of ecology in their subjects"; "I do not like to hear about ecology as it goes against progress"; "I believe that it is important to be aware of the impact of our behavior on the environment". The maximum score was 45.

Students with the highest (from 30 to 40) and lowest scores (from 9 to 20) in this questionnaire were selected to participate in the second phase of the study.

Second phase

A total of 163 students were selected from the 302 by combining their scores in the diagram and prior knowledge questionnaire with their scores in the topic interest questionnaire. Three of the selected students were not at school the day on which the experiment took place, thus 160 students participated. The 160 students (107 girls and 53 boys) were distributed as follows.

1. HH students were those with the highest scores in both dimensions, prior knowledge and topic interest (n = 56);
2. LL students were those with the lowest scores in both dimensions, prior knowledge and topic interest (n = 37);
3. HL students were those with the highest scores in prior knowledge and the lowest scores in topic interest (n = 35);
4. LH students were those with the lowest scores in prior knowledge and the highest scores in topic interest (n = 32).

Older and younger students were equally distributed across the groups.

Materials

Texts. Three versions of a scientific text about the greenhouse effect (see Ozenda & Borel, 1993), regarding both its natural and pathological aspects, were prepared by the authors. The first version was minimally coherent (MC), the second only locally coherent (LC), and the third both locally and globally coherent (LGC). Local coherence was obtained by making connections between sentences explicit and repeating some words to increase text connectedness. Global coherence was obtained by adding topic headers and macropropositions linking each paragraph to the rest of the text and overall topic. The content of the three versions was the same. The text was articulated into 6 subtopics: the increase in the surface temperature of the earth; the function of the natural greenhouse effect; the impact of industrial development on the earth's atmospheric composition; the negative effects of increased global warming from a hydrological point of view; the situation of Alps' glaciers, and the need for a common commitment to face the problem. The minimally coherent text was 1,578 words long, the locally coherent text was 1,802 words, and the locally and globally coherent text 2,092 words.

The three different versions were read by a number of students in each of the four groups (see Table 1).

Table 1. Number of students of the four groups who read the different text versions.

Text version / *Group*	Minimally Coherent (MC)	Locally Coherent (LC)	Locally and Globally Coherent (LGC)
HH	19	18	19
LL	14	12	11
HL	12	13	10
LH	12	11	9

Procedure

In the second phase (two weeks after the first session) the 160 participants were tested in a room at their school, approximately 15 at a time. They were given unlimited time to carry out the tasks. The sessions lasted from about one hour and 40 minutes to two hours and 15 minutes. The sequence of the experimental tasks was as follows: (a) text reading, (b) diagram, (c) text recall, (d) bridging-inference questions, (e) problem-solving questions.

Tasks

Text reading. The participants were asked to read one of the three texts silently. When finished, they were asked to re-read it for a better understanding.

Diagram. The same diagram used in the pretest was also used as post test after reading the text. It was used to assess the changes in students' knowledge organization as a result of reading the experimental texts. These changes would be indicative of the readers' situation model.

Text recall. The participants were asked to recall as much of the text as they could by writing it down. Recall can be considered a measure of the text base formed by the participants during reading. As McNamara et al. (1996) pointed out, text recall has a reproductive and a reconstructive component since there is an admixture of reconstructions which derive from the situation model the readers have constructed, especially when they are familiar with the text topic or the text base can no longer be retrieved. In this experiment with short-term tests and a number of low-knowledge readers, however, we assumed that the reproductive component of recall related to the text base would usually dominate. The three texts were propositionalized according to the principles specified in van Dijk and Kintsch (1983). Text recall was quantified in terms of the number of propositions remembered from the texts. The total number of propositions in the MC version was 105 (maximum score).

Post test questions. Participants answered two sets of open-ended questions about text content. There was a total of 10 questions divided into two different types.

a. Bridging-inference questions. This type of question required linking separate sentences of the text. For example, one bridging-inference question was: "Why is the greenhouse effect beneficial *per se*?" To answer this question, the reader had to make the inference that the greenhouse effect is beneficial since, as a natural phenomenon, it maintains atmospheric temperature at levels necessary for life on the earth. To make this inference, the reader had to link the sentence which says that the greenhouse effect is not new as it has always existed, with the sentence which says that without this phenomenon the earth's temperature would be much lower, like on the moon.

b. Problem-solving questions. This was a knowledge transfer task. It required linking information from separate sentences and applying it to a novel situation. An example is: "It is possible to reduce the emission of gases that increase the greenhouse effect? In what way(s)?".

Answers to both types of questions depended on a well-formed situation model. All answers were scored blind by two independent judges. Some were scored from 0 to 1 and others from 1 to 2 on the basis of their correctness and completeness. The maximum score for the bridging-inference questions was 8 and for the problem-solving questions 7. A wide sample of answers (75%) was also coded by another independent judge. Agreement between them was 94% for the bridging-inference questions and 90% for the problem-solving questions. All disagreements were discussed between the two judges in the presence of the authors until consensus was reached.

Results

Analyses

A MANOVA including the three between-subject variables of text (minimal coherence, local coherence, local and global coherence), prior knowledge (low knowledge, high knowledge), and topic interest (low interest, high interest) was performed for the dependent measures, with post-hoc tests. An ANOVA for repeated measures was calculated for the diagram task carried out before and after reading the experimental texts. Moreover, *t* tests were performed to compare pairs of groups for each dependent measure.

Overall

The MANOVA revealed two main effects, group and version. The first was related to the participant group, that is their level of prior knowledge and topic interest, F (3, 148) = 4.70, $p < .001$, the second was related to the level of text coherence, F (2, 148) = 4.42, $p < .001$. No interaction between the two variables was found. Concerning group effect, the HH group outperformed the other three in all tasks, regardless of text coherence, whereas the LL group scored lowest in all tasks except the problem-solving questions, where scores were very slightly higher than the LH group. Between the HH and LL groups were the HL and LH groups. The HL group followed the HH group in all tasks but the recall. Concerning the text version effect, there were differences in performance due to the level of text coherence in the diagram task and in the two types of questions, but not in the recall task. These general findings substantially confirmed our hypothesis that the HH group would perform best regardless of text coherence, and the LL group worst, although the type of the text version did not influence all tasks in the same way (for the scores of all tasks see Table 2 in Appendix). For a deeper analysis of the observed effects, the results are now introduced separately for each task.

Recall

The MANOVA revealed a group main effect, F (3, 148) = 10.13, $p < .001$. The post-hoc test revealed that the HH group attained the highest scores, followed by the LH, HL and LL groups.

The text version did not significantly differentiate performance on the surface level of understanding, but the HH group obtained the highest scores with the minimally coherent text (MC), whereas the LH group scored higher with the locally and globally coherent text (LGC). These findings are in line with those by Kintsch and collaborators' research group. The results of the other two groups, HL and LL, with students with low topic interest are not linear, in that the scores did not increase with a locally and globally coherent text compared with a minimally or locally coherent text (see Fig. 1).

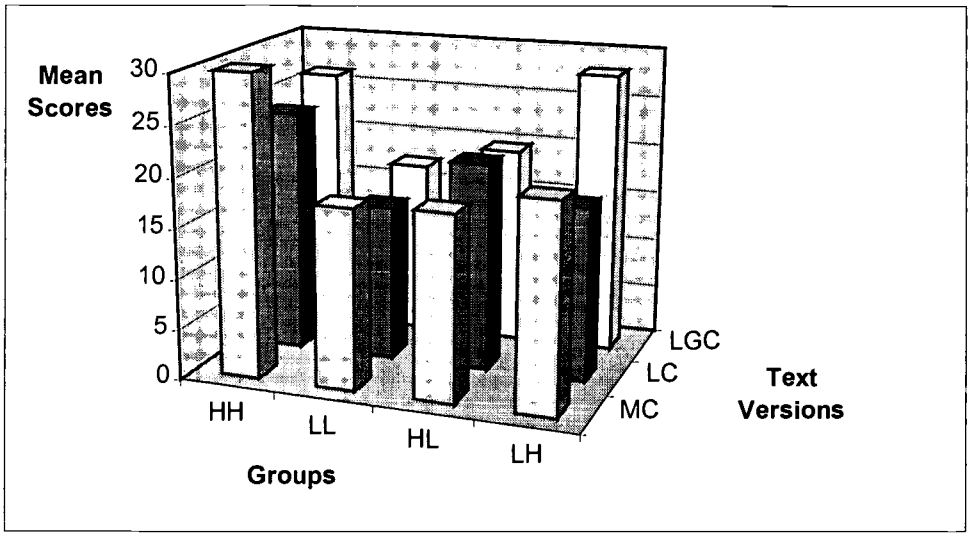

Figure 1. Mean scores in the recall task of the four groups for the three text versions.

Diagram

An ANOVA for repeated measures showed a main effect due to time. All four groups increased their performance between the pre- and post-reading diagrams, F (1, 148) = 285.83, $p < .001$. There was also a significant time x group interaction as the four groups differentiate in the post-reading diagram: the HH group benefited most from reading and obtained the best scores, followed by the HL, LH, LL groups, F (3, 148) = 3.64, $p < .05$. In addition, there was a significant time x version interaction as the level of text coherence differentiated performance in this task by tapping the deeper levels of students' understanding based on the situation model they were able to construct, F (2, 148) = 12.84, $p < .001$. Interestingly, in this task the locally and globally coherent text (LGC) produced the best performance for all four groups (see Fig. 2).

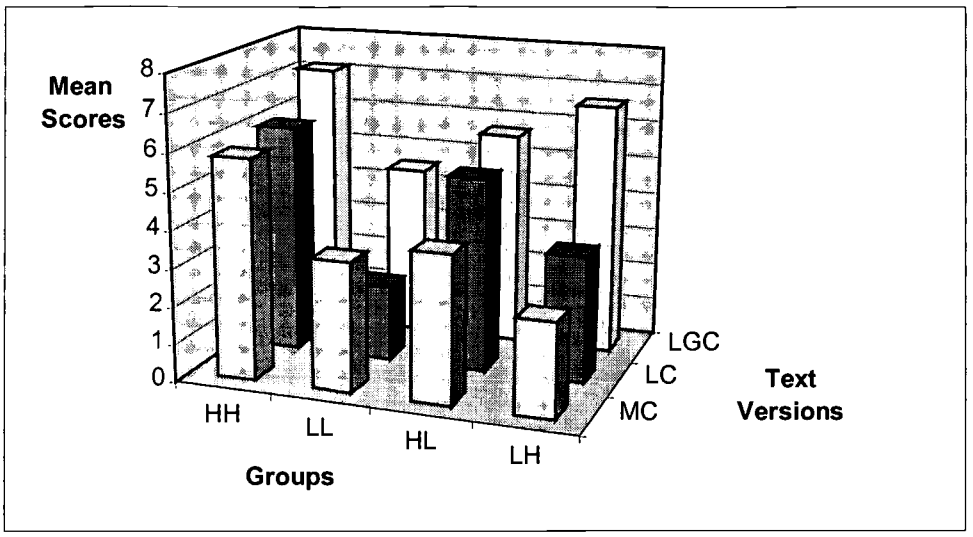

Figure 2. Mean scores in the post-reading diagram task of the four groups for the three text versions.

Bridging-inference questions

The MANOVA revealed both a group main effect, $F(3, 148) = 5.51$, $p = .001$ and a version main effect, $F(2, 148) = 6.58$, $p = .002$. As for the post-reading diagram, post hoc tests showed that the order of the groups' performance, from highest to lowest, was: HH, HL, LH, LL. Moreover, the students in the LL, HL and LH groups answered this type of question more accurately with the locally and globally coherent text (LGC), whereas those in the HH group did so reading the minimally coherent text (MC) (see Fig. 3). This last finding is also in line with McNamara and Kintsch (1996) and McNamara et al.'s (1996) results.

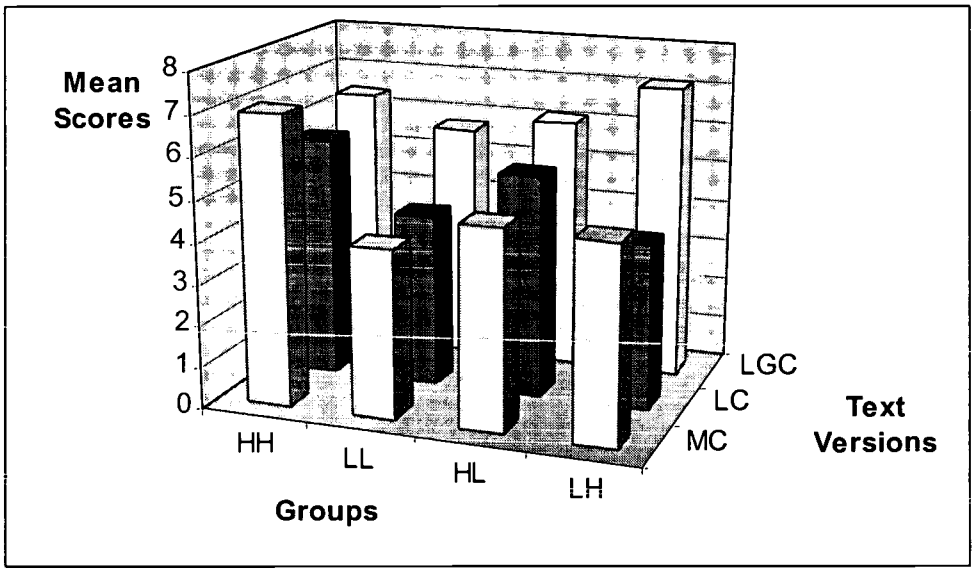

Figure 3. Mean scores in the bridging-inference questions of the four groups for the three text versions.

Problem-solving questions

The MANOVA revealed both a group main effect, $F(3, 148) = 9.85, p < .001$ and a version main effect, $F(2, 148) = 4.75, p = .01$. From the post hoc tests it emerged once again that the HH group performed best, followed by the HL, LL and LH groups. Only in this case did students with low prior knowledge and low topic interest outperform the students with low prior knowledge but high topic interest. Moreover, the LL, HL and LH groups also answered this type of question more accurately reading the locally and globally coherent text (LGC). The HH group performance was not highly differentiated after reading the three versions of the text. However, this group attained the highest scores with the minimally coherent text (MC) and the lowest after reading the locally and globally coherent text (LGC) (see Fig. 4).

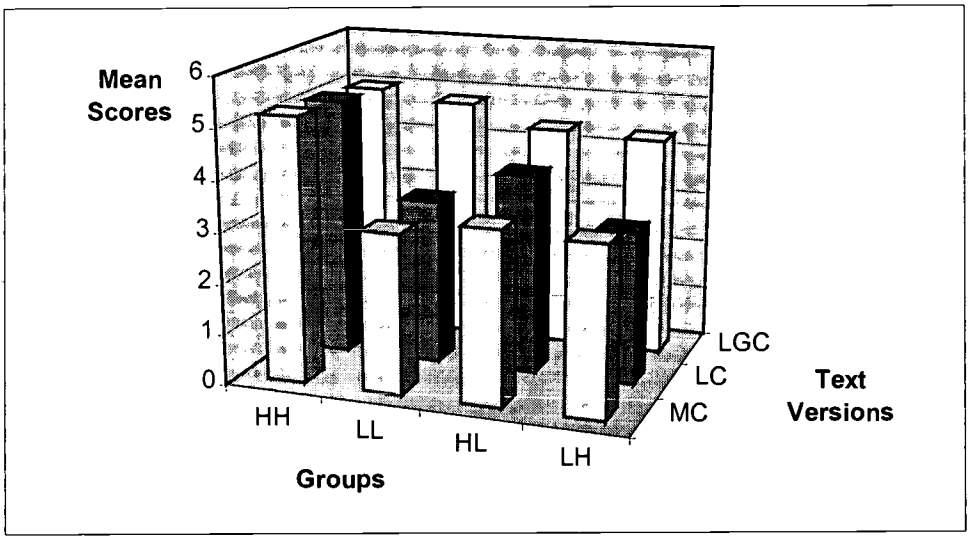

Figure 4. Mean scores of the four groups in the problem solving questions for the three text versions.

Comparisons between pairs of groups for topic interest

To highlight the role of topic interest - the third variable we introduced in this study - two *t* tests were performed to compare the scores in the four tasks by groups of students who differentiated for topic interest only and not level of prior knowledge, either high or low; that is, between HH and HL groups and between LH and LL groups. It can be seen that topic interest played a role in LL and LH groups at the level of the text-base

understanding as these two groups differentiated significantly in the recall task, t (67) = 2.11, p < .05. HH and HL groups differentiated in all four tasks, that is, at both the level of text-base and situation model understanding. For the diagram task, t (89) = 2.52, p < .05; for the recall task, t (89) = 4.09, p < .001; for the bridging-inference questions, t(89) = 2.35, p <.05; for the problem-solving questions, t (89) = 3.89 , p < .05 (see Fig. 5). No differences emerged between the HL and LH groups, that is, between the groups of students characterized by lack of either prior knowledge or topic interest.

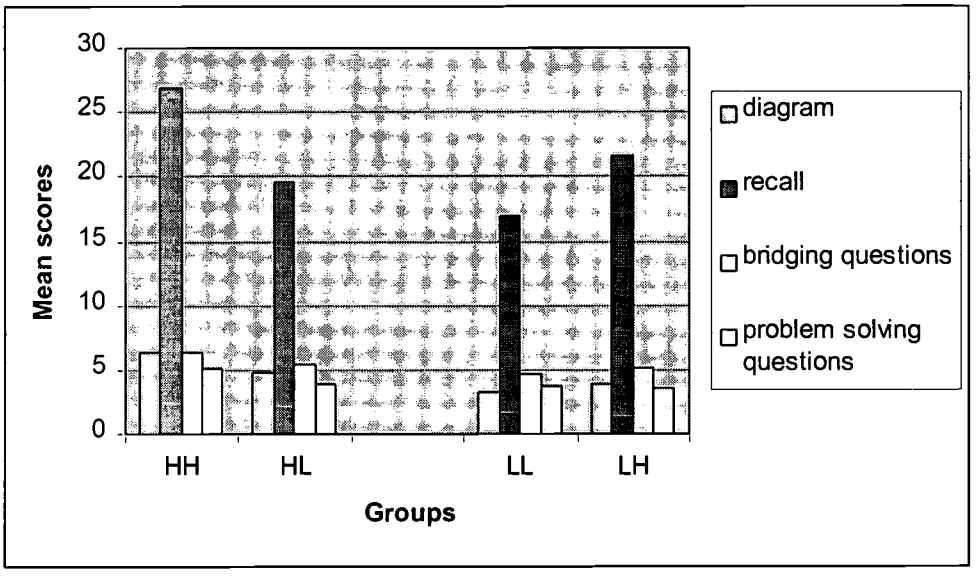

Figure 5. Comparisons between the mean scores in the four tasks of the groups with same levels of knowledge but different levels of topic interest.

Discussion and implications

This study was aimed at expanding previous research about the interactive effects of readers' prior knowledge and text coherence on learning by introducing a third variable, topic interest. A necessary condition for a deeper understanding of the complex process of learning from text is a consideration of the three crucial variables which had been investigated separately, or in their two by two relationships.

First of all, the validity of Kintsch and collaborators' model of text understanding should be highlighted; it provided a useful and effective framework for studying the issues addressed here. We used different measures aimed at tapping the two different

levels of understanding: text-base, through the recall task and situation model, through the diagram task and bridging-inference and problem-solving questions. As McNamara et al. (1996) pointed out, the distinction between measures of a superficial and a deeper understanding of a text is a matter of degree rather than absolute. Free recall can also be based on a situation model as well as text-base effects involved in answering inference questions. However, recall is more text-base dependent, whereas the diagram and both types of questions are more situation-model dependent (Kintsch, 1998).

An expansion of the findings from the above-mentioned studies was made possible by the introduction of a third variable, topic interest, that is readers' relatively stable affective orientation towards a topic.

The results substantially confirm our hypotheses that high-knowledge and high-interest readers (HH group) would perform best regardless of text coherence. On the contrary, high-knowledge and low-interest readers (HL group) would perform better with the locally and globally coherent text as would low-knowledge and high-interest readers (LH group). Moreover, it was hypothesized that low-knowledge and low-interest readers (LL group) would perform worst, especially with the minimally coherent text.

With the exception of the recall task aimed at tapping text-based understanding, in which the text version did not differentiate the groups in remembering textual information, in the other three tasks the HL and LH groups benefited more from reading a locally and globally coherent text. This means that text understanding through the construction of a situation model was facilitated by the most coherent and explicit (LCG) text for the students who had either high knowledge but low topic interest, or low prior knowledge but high topic interest. Such a text version required an adequate level of active processing for those students. The minimally coherent or only locally coherent texts were not optimal for students who could not rely on prior knowledge and topic interest. They were unable to process inferentially on their own, so a fully coherent, non demanding text which did this processing for them was the most appropriate and productive. This does not mean that while reading the MC text no active processing occurred, as readers had to necessarily process text information. The active processing we refer to here involves the production of knowledge from the knowledge base and its addition to the information in the text. When either the readers'

prior knowledge or topic interest is low, active processing alone may be too difficult. Therefore if a text does this processing for them, their understanding may be greater.

As expected, the LL group obtained the lowest scores in all tasks, especially after reading the minimally coherent text, except in the problem-solving questions in which they slightly outperformed the LH group after reading the locally and globally coherent text. In this task the students in the LH group also revealed a deeper understanding after reading the LCG text, although their level of learning was the lowest.

The HH group attained the best results, taking advantage of a minimally coherent (MC) text in both the bridging-inference and problem-solving questions, but not in the diagram task, where they also benefited from the most coherent (LCG) text. In our case allowing the high-knowledge and high-interest students make their own inferences through extra processing, that is, presenting reading material which requires participants to provide coherence themselves, led them to answer both types of questions more accurately. The same text version, however, did not produce the same results in the diagram task, which was aimed at checking the students' conceptual organization. This cannot be easily explained and more work needs to be done to explore this matter.

Overall, these findings are substantially consistent with those of the two above-mentioned studies. However, it should be pointed out that in our study prior knowledge interacted with topic interest. The study gives more insight into the relationship between cognitive and affective aspects of learning and cognition as it analyzes text understanding taking into account both variables and their interaction.

On the one hand, previous studies on topic interest (e.g. Schiefele, 1992, Schiefele & Krapp, 1996) have shown that it is more closely related to indicators of deep-level learning than to measures of surface-level learning. On the other hand, other studies (e.g. Schiefele, 1996; Schiefele & Krapp, 1996) have found that topic interest is significantly related to recall of idea units, elaborations, and main ideas independently of prior knowledge, or weakly associated with it.

This study shows the interaction between prior knowledge and topic interest. It can be said that when prior knowledge is low, topic interest can compensate for it and, at least, help organize text information by extracting semantic information and constructing an interrelated network of propositions (text-base understanding). In fact, no significant differences in any task were found between the HL and LH groups. When

prior knowledge is high, topic interest can help not only understand at the text-base but also the situation-model level. In other words, if the knowledge students already possess is not enough to sustain a deep level of text understanding, topic interest may be sufficient to lead them to a surface understanding (differences between the LL and LH groups). Whereas when students with high prior knowledge read a text, topic interest may help them learn from text at both surface and deeper levels (differences between the HH and HL groups). They are able to integrate the information provided by the text with their prior knowledge, and reorganize and restructure it on the basis of a deep understanding of the topic. In other words, this means the production of conceptual change.

In sum, it can be said that the interaction between cognitive and affective aspects of learning from text is undoubtedly complex as different levels of understanding can be reached in relation to different types of text, prior knowledge, and topic interest. A number of problems emerge from this study and future research needs to investigate the complexity of this interaction further.

(1) Future studies should address the question of learning from text for conceptual change more specifically. In the case of expository texts on topics of which students may have a rich prior knowledge made up of alternative conceptions, a deeper understanding of the text involves restructuring conceptions that conflict with scientific explanations offered in the text. As highlighted clearly (Vosniadou, 1994, 2000), restructuring is a slow and gradual process often requiring a change in entrenched presuppositions that lead to forming alternative models of phenomena and events. A future research question may concern the extent to which topic interest and text coherence (structural and explanatory), interacting with prior knowledge, sustain students' use of active text processing strategies which are necessary for recognizing differences between their ideas and those of the text, for coping with those differences, and restructuring their conceptual frameworks to successfully integrate the new information (Roth, 1991).

(2) Future studies should distinguish different types of interest. Not only topic interest should be considered but also situational interest which may vary in stability. Situation specific interest, for example, may be more or less stable in relation to the

content of the different parts of a text or the level of processing difficulty a student may experience through a text.

(3) Future studies should test the stability of learning effects over time. The present study involved only short-term learning, whereas students have to face long-term learning requirements to be successful in and out of school.

Finally, from the educational perspective, an implication of this study points to the importance of adjusting text structure to students' cognitive and affective individual differences. Not all students may benefit from the same text and there is not a single text appropriate to a supposed average student. A level of coherence should be appropriate to the quantity and quality of students' prior knowledge as well as their topic interest in order to encourage the inference processes that they can actually activate. If they are involved in filling in information gaps, it means that they are using the knowledge they already possess as they read. This use is a necessary condition for producing effective learning from texts - undoubtedly a very complex, but challenging, educational task for sustaining understanding in all students.

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Appendix

Table 2. Means and standard deviations of the four groups in all tasks after reading the different text versions.

Group	*Version*		*Drawing*	*Recall*	*Bridging inference questions*	*Problem solving questions*
HH	MC	M	5.84	30.00	7.00	5.21
		N	19	19	19	19
		SD	2.52	11.59	2.49	1.55
	LC	M	6.06	24.06	5.83	5.11
		N	18	18	18	18
		SD	2.46	9.03	2.31	1.64
	LCG	M	7.16	26.32	6.42	5.00
		N	19	19	19	19
		SD	2.03	10.33	2.67	1.41
	Total	M	6.36	26.84	6.43	5.11
		SD	2.38	10.50	2.50	1.51
LL	MC	M	3.43	17.86	4.07	3.14
		N	14	14	14	14
		SD	3.37	9.65	1.49	1.41
	LC	M	2.00	15.42	4.17	3.25
		n	12	12	12	12
		SD	3.28	7.68	1.95	1.42
	LCG	M	4.55	17.36	5.73	4.82
		n	11	11	11	11
		SD	3.27	7.26	1.49	1.83
	Total	M	3.30	16.92	4.59	3.68
		SD	3.37	8.21	1.77	1.68
HL	MC	M	3.92	18.33	4.83	3.42
		n	12	12	12	12
		SD	3.06	5.07	1.03	1.08
	LC	M	5.15	20.62	5.38	3.92
		n	13	13	13	13
		SD	2.85	7.22	2.02	1.75
	LCG	M	5.70	19.70	6.10	4.40
		n	10	10	10	10
		SD	2.67	7.27	1.66	0.97
	Total	M	4.89	19.57	5.40	3.89
		SD	2.89	6.45	1.67	1.37
LH	MC	M	2.50	20.50	4.75	3.33
		n	12	12	12	12
		SD	3.21	8.67	2.05	1.67
	LC	M	3.36	17.27	4.00	3.00
		n	11	11	11	11
		SD	2.87	8.83	2.93	1.26
	LCG	M	6.67	28.11	7.11	4.33
		n	9	9	9	9
		SD	1.41	10.20	1.62	2.18
	Total	M	3.97	21.53	5.16	3.50
		SD	3.15	9.91	2.57	1.74

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